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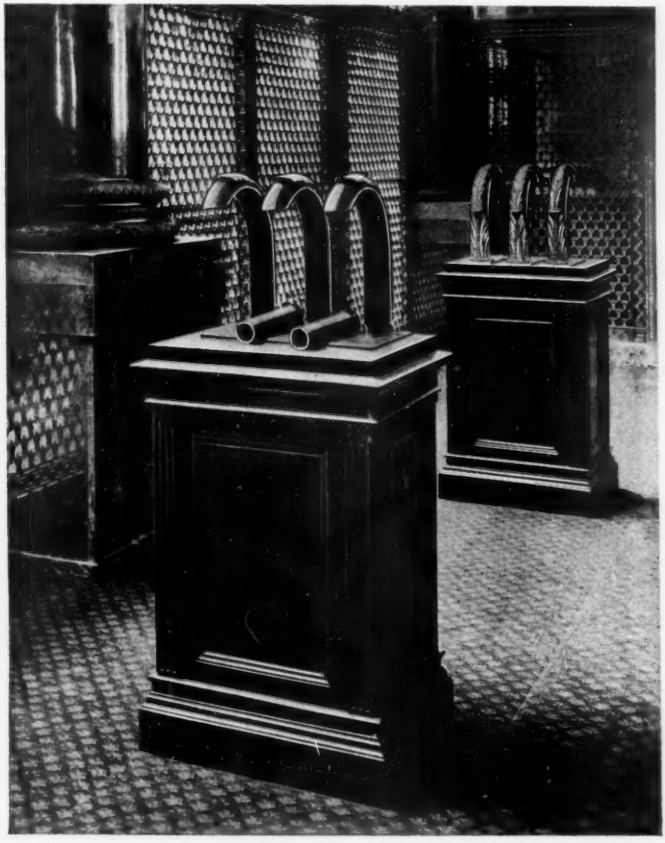
VOL. II. NEW YORK, JANUARY 1898. NO. 11



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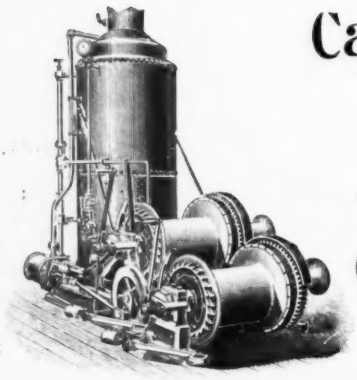

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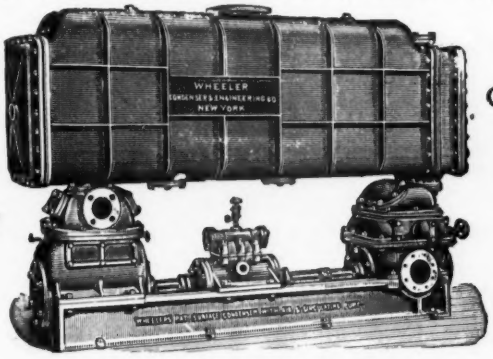

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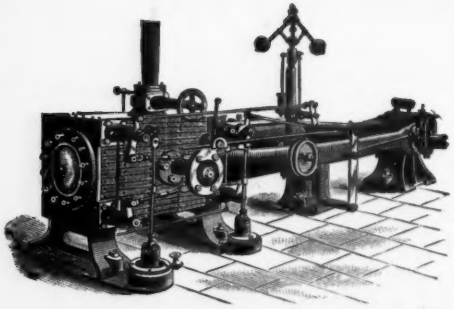

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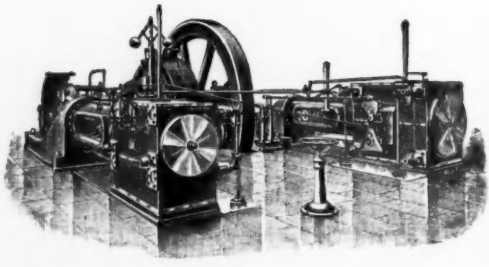

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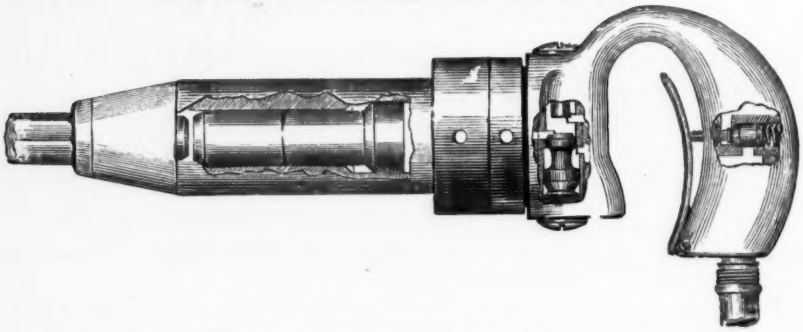

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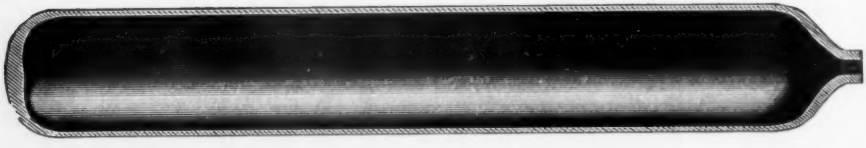

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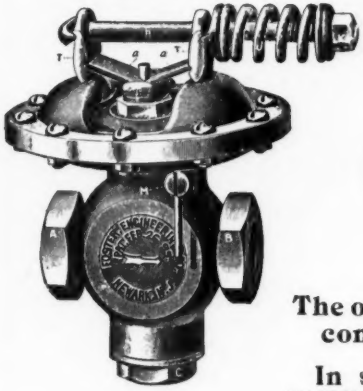

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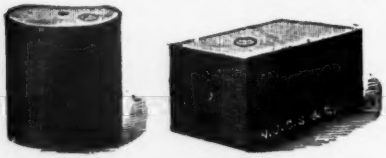

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Those who fail to receive papers promptly will please notify us at once.

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VOL. II. JANUARY, 1898. NO. 11.

We have received a number of communications from our correspondents on the subject of a paper which appeared in the December number of COMPRESSED AIR, entitled "Cold Storage and Cold Rooms from Compressed Air," by Mr. G. D. Hiscox. We publish some of these communications in this issue, and will be very glad to continue the discussion, which can not fail to be productive of good results.

This is a subject about which a great deal may be said and concerning which there is a wide diversity of opinion. There are many things about compressed air in respect to which engineers differ; in fact, we know of no science of equal importance which is less subject to well-defined rules than that of compressed air. The laws of thermodynamics are complex. Rules that apply to dry air must be corrected for air under normal conditions, for there is no such thing in general practice as dry air. Heat and cold, which are so much in evidence when treating of compressed air, are only relative terms. We do not really know what heat is; in fact, our best judgment is that there is no such thing as heat; that it is only the sensible effect of motion; hence, it is natural to expect that a paper upon "Cold Storage by Compressed Air" might contain matter so purely theoretical that engineers will not agree with the conclusions derived.

COMPRESSED AIR does not pretend to be responsible for the ideas given by its correspondents over their signatures. Mr. Hiscox is a well known mechanical engineer of acknowledged ability and of wide experience; he is as competent perhaps to treat of this subject as anybody else, and is just as liable to make mistakes or to indulge in theories which may not accord with practice. The trouble is that we have so little practice on this subject that our ideas and conclusions must be largely matters of theory.

Prof. Sims, of the State University of Iowa, whose letter is published in this issue, has very properly called attention to an error of figures in Mr. Hiscox's article. This has been corrected by Mr. Hiscox, who promptly saw the point made by Prof. Sims.

The error of $\frac{1}{800}$ as the relative heat value of equal volumes of air and water should have been $\frac{1}{3413}$ and the result of the computation should have been divided by the specific heat of air .2377, making 17.9 lbs., or 232 cubic feet of air required to cool the room and extending the time of cooling to one hour.

The actual expansion temperature from — 138 to the required temperature of the room is — 138 + 34 = 172° Fahr., which should have entered the formula, making it

$$\frac{841}{172 \times .2377} = 40.88 \text{ lbs. of air, or } 531.^{44}$$

cubic feet of air. The compressor of 5 cubic feet capacity would then require nearly two hours to reduce the temperature of the room to 34°, and somewhat longer when the room is charged with its storage of material having a greater specific heat than air.

Mr. Dickerson makes the point that the figures given by Mr. Hiscox are entirely theoretical and that theoretical temperatures due to the expansion of cold air can not be approached in practice. This statement is, we think, quite true. The theoretical figures given by Mr. Hiscox, when based on the free expansion of air, can not be reached in practice; but when the air is used to do work in the cylinder of an engine, as for instance a pump, the cooling effect is very great, and in degree we think it follows closely the theoretical figures. Where water is present—as it always is—the specific heat of water will affect the air and prevent extreme temperatures being reached, but the simplest and most practical way to get a low temperature through the expansion of compressed air

is by letting it do work and exhaust into the chamber to be cooled. The cold air is in this way produced exactly as the heat is produced at the compressor, and it should be equal in degree. The piston of an air compressor does a certain amount of work upon the air, this air does no work in return, hence the resultant effect of this work is heat. Heat and mechanical energy, or heat and work, are convertible terms. We can produce heat by work, or we can produce work through heat, converting one into the other with as much certainty as we can convert ice into water, or electricity into heat, or water into steam.

Sir Humphry Davy, in the year 1799, published a paper giving the results of experiments which determined the true relation between heat and motion. He showed a case in which there was actual conversion of mechanical power into heat. This was accomplished by the rubbing together of two pieces of ice until they were melted and converted into water. In this case the heat which prodnced this conversion could not have come from the ice, because after the melting had taken place the temperature of the water was slightly above the freezing point, that of the ice remaining the same; nor could this have come from surrounding bodies because of the nature of the experiment, hence Davy reaches the conclusion that "Heat or that power which prevents the actual contact of the corpuscles of bodies, and which is the cause of our peculiar sensations of heat and cold, may be defined as a peculiar motion, probably a vibration of the corpuscles of bodies tending to separate them."

In Davy's work on "Chemical Philosophy" he makes the statement that "The immediate cause of the phenomena of heat is motion, and the laws of its communication are precisely the same as the laws of the communication of motion."

The laws that govern the production of heat apply equally and in the same degree to the production of cold. We know that where pumps in mines are driven by compressed air, freezing at the exhaust is a common difficulty, and it is well known that the air discharged from the exhaust is cold. The degree of cold depends upon the expansion. If the air is admitted to the pump at a high pressure and is exhausted, the lowering of temperature will be greater than if admitted at a lower pressure Where there is no cut-off, as in the case of a common mine pump, it would seem that the low temperature is produced not so much within the cylinder as at the exhaust. With a cut-off valve as in the case of steam engines, the air is admitted, cut off, and expanded down to a point near atmospheric pressure before the exhaust takes place, in this case the lowering of temperature takes place within the cylinder; but with a common pump it is likely that the contraction of section produces at the point of contraction a very high resistance.

This brings us to the consideration of an interesting and quite unexplained condition of things If we have a tank charged with compressed air and let the air be discharged through a free opening into a room, there will be practically no reduction of temperature except immediately at the nozzle, and even here the reduction is slight. Mr. Moran, Mechanical Engineer for Sooysmith & Co., tried an experiment with air expansion with a view of freezing loose ground. He drove pipes into the ground which were connected at one end with a tank containing compressed air, and open at the other. These pipes were connected in series, so that when the valve was opened the air from the tank would pass through them, reaching atmospheric pressure at the other end. There was not only no reduction in temperature, but on the contrary there was a slight increase.

This and similar experiments have shown us that the simple discharge of compressed air through an opening into the atmosphere does not produce refrigeration; but when this discharge takes place through a very fine opening, the cold is intense. Even liquid air has been produced by simply expanding compressed air from high pressures down to atmospheric pressnre through contracted openings. We know that in electricity the passage of a current through a contracted medium, as for instance through a fine wire, produces heat. This is shown in the common incandescent lamp, yet when we pass compressed air through a finely restricted medium, as for instance an opening the size of a needle, the reverse is true—that is, cold is produced; and the higher the pressure of the air or the greater the resistance, the more marked is the reduction of temperature.

It has been suggested that in the case of air internal work is done in overcoming the resistance at the opening and that it is the heat which is abstracted from the air in doing this work which accounts for the extreme low temperature results.

The Flow of Compressed Air in Pipes.

BY WILLIAM COX.

The volume of a fluid discharged from a pipe is very easily ascertained by means of the formula

$$D = \frac{v \times 0.7854\ d^2 \times 12 \times 60}{1728}$$

$$= v \times d^2 \times 0.32725 \ldots\ldots\ldots\ldots (1).$$

Where D = discharge in cu. ft. per minute,
v = mean velocity of flow in feet per second,
d = internal diameter of the pipe in inches.

With this formula it however generally happens that the velocity v is an unknown quantity, as the application of indicating instruments is either difficult or altogether impossible in existing pipe installations, and out of the question in the case of new ones when being designed. Recourse must therefore be had to some other means to ascertain the actual or required rate of flow of the fluid, and to this end scientists and engineers have long directed their best energies.

It is well known that if it were possible to eliminate all kinds of friction and other opposing forces, the velocity of flow of water in a pipe would be the same as the velocity acquired by a heavy body which has fallen from a height equal to the head of water; that is—

$$v = \sqrt{2\,g\,h} = 8.02\ \sqrt{h} \ldots\ldots (2).$$

where v = final velocity in feet per second of the falling body,
h = head of water, or space fallen through in feet,
g = the force of gravity = 32.16.

In the case of fluids flowing through pipes there are, however, various opposing forces and other influencing circumstances, all of which (as they produce friction and affect the velocity or rate of flow, and materially diminish the practical value of the head), must be taken into consideration. These may be briefly classified as follows:

1. Friction induced by the fluid entering the pipe. This is comparatively small, so that it need not be taken into account when considering pipes of a length equal to 400 or 500 times their diameter, or what are termed *long pipes*.

2. The friction caused by the flow of the fluid in the pipe. This is proportional to the length of the pipe, when the velocity is the same throughout, also to the circumferential area of the inner surface of the pipe. It also varies in intensity in proportion to the internal condition of the pipe, and is likewise affected by the density of the fluid. This latter cause of velocity is not apparent in the case of water, as being an almost incompressible body, its density is not appreciably affected by changes of pressure, but in the case of elastic fluids such as air, steam or gas, this factor is an important one and must always be taken into account.

A general formula applicable to the flow of water in clean pipes, deduced from these considerations, is

$$v = c \sqrt{\frac{d \times h}{l}} \ldots\ldots\ldots\ldots (3)$$

where v = velocity of flow in feet per second,
d = diameter of the pipe in inches,
h = total head of water in feet,
l = length of pipe in feet,
c = a variable co-efficient to be determined by experiment.

It was found by D'Arcy and some others that the co-efficient c was not a constant one to be used for all sizes of pipes. D'Arcy devoted much time to the working out of a series of co-efficients applicable to various diameters of pipes, and this formula so modified has been generally accepted as giving approximately correct results.

It has also been affirmed by some engineers of authority that this formula is also applicable to the flow of an elastic fluid in a pipe by the insertion of a term denoting the density of the fluid. Replacing in Eq. (3) the term head of water

by its equivalent pressure in pounds per square inch, we then obtain

$$v = c \sqrt{\frac{d \times (p_1 - p_2)}{w_1 \times l}} \quad \ldots\ldots (4)$$

where p_1 = initial gauge pressure in lbs. per square inch,

p_2 = final gauge pressure in lbs. per square inch,

$p_1 - p_2$ = difference of pressures, or pressure required to overcome friction and produce the velocity of flow, equivalent to the loss of head,

w_1 = density or weight in lbs. per cu. ft. of the fluid at the initial pressure p_1.

The other letters represent the same terms as in previous equations.

If the value of v as given in Eq. (4) is inserted in Eq. (1), we obtain

$$D = c \sqrt{\frac{d^5 \times (p_1 - p_2)}{w_1 \times l}} \quad \ldots\ldots (5).$$

which gives the discharge of compressed air in cu. ft. per minute from a pipe of any diameter and length, with any initial and final pressures, the volume of discharge thus obtained being under the terminal pressure p_2. To apply this formula to practical use, D'Arcy's co-efficients for different actual diameters of pipes, modified to suit the conditions of elastic fluids, are here given.

TABLE I.

Diam.	Co-effic't.	Diam.	Co-effic't.
1 inch	45.3	8 inches	60.7
2 inches	52.7	9 "	61.2
3 "	56.1	10 "	61.8
4 "	57.8	12 "	62.1
5 "	58.4	14 "	62.3
6 "	59.5	16 "	62.6
7 "	60.1		

To further simplify calculation, the following table gives the values of $c \sqrt{d^5}$, and if we call this term x, we then obtain the simpler formula

$$D = x \sqrt{\frac{p_1 - p_2}{w_1 \times l}} \quad \ldots\ldots (6)$$

The values of $x = c \sqrt{d^5}$ in this table are slightly modified so as to make them conform to a perfect curve.

TABLE II.

Diam'r.	C.	$x = c \sqrt{d^5}$
1 inch	45.3	45.3
2 inches	52.5	297
3 "	56.2	876
4 "	58.0	1856
5 "	59.0	3298
6 "	59.8	5273
7 "	60.3	7817
8 "	60.7	10988
9 "	61.2	14872
10 "	61.6	19480
11 "	61.8	24800
12 "	62.0	30926
13 "	62.2	37798
14 "	62.3	45690
15 "	62.5	54462
16 "	62.6	64102

It must of course be understood in connection with all pipe calculations that the diameters referred to are always the actual ones and not the nominal ones, otherwise considerable divergences may be obtained between the calculated and the real discharges. Thus the actual inside diameter of a 1-inch pipe, "Standard" dimensions, is 1.048 inches, giving a sectional area of nearly 10 per cent. more than the nominal one. The following table gives the nominal and the actual diameters and areas of "Standard" steam, gas and water pipes. It is taken from "Book of Standards," issued by the National Tube Works Co.:

TABLE III.

	Nominal.		Actual.	
Diam'r.		Area.	Diam'r.	Area.
1 inch		0.7854	1.048	0.8626
2 inches		3.1416	2.067	3.356
3 "		7.0686	3.067	7.388
4 "		12.5664	4.026	12.73
5 "		19.635	5.045	19.99
6 "		28.274	6.065	28.888
7 "		38.485	7.023	38.738
8 "		50.266	7.982	50.04
9 "		63.617	8.937	62.73
10 "		78.540	10.019	78.839
11 "		95.033	11.25	99.402
12 "		113.10	12.00	113.098
13 "		132.73	13.25	137.887
14 "		153.94	14.25	159.485
15 "		176.71	15.25	182.655

These real diameters should always be taken into account when using the formulas, and if not actually inserted in them, the differences existing should be allowed for.

To further facilitate the investigation of this formula, Table IV. is added, giving

the values of w_1 and $\sqrt{w_1}$ in equations (5) and (6) for pressures up to 100 pounds, calculated from the formula

$$w_1 = 0.0761\ (0.068\ p_1 + 1).....(7)$$

where p_1 = the initial gauge pressure of the air in lbs. per square inch, at the entrance to the pipe.

TABLE IV.

Gauge Pressure.	w_1	$\sqrt{w_1}$
0 pounds	0.0761	0.276
5 "	0.1020	0.319
10 "	0.1278	0.358
15 "	0.1537	0.392
20 "	0.1796	0.424
25 "	0.2055	0.453
30 "	0.2313	0.481
35 "	0.2572	0.507
40 "	0.2831	0.532
45 "	0.3090	0.556
50 "	0.3348	0.578
55 "	0.3607	0.600
60 "	0.3866	0.622
65 "	0.4125	0.642
70 "	0.4383	0.662
75 "	0.4642	0 681
80 "	0.4901	0.700
85 "	0 5160	0.718
90 "	0.5418	0.736
95 "	0.5677	0.753
100 "	0.5936	0.770

When, as is generally the case, it is required to know the equivalent volume of free air corresponding to the volume of compressed air discharged, this latter, or D, must be multiplied by the density of the air at terminal pressure as related to the density of the atmosphere. We have for this purpose the following formula:

$$F = D \times W_2 .....(3).$$

in which D = volume of compressed air discharged at final pressure,

F = equivalent volume of free air,

W_2 = density of the discharged air in atmosph's, $= (0.068\ p_2) + 1$,

p_2 = final gauge pressure in lbs. per sq. in. of the disch'ged air.

The following table of values of w_2 will be found of use in solving such problems:

TABLE V.

P_2	W_2	P_2	W_2
0 pounds	1.00	55 pounds	4.74
5 "	1.34	60 "	5.08
10 "	1.68	65 "	5.42
15 "	2.02	70 "	5.76
20 "	2.36	75 "	6.10
25 "	2.70	80 "	6.44
30 "	3.04	85 "	6.78
35 "	3.38	90 "	7.12
40 "	3.72	95 "	7.46
45 "	4.06	100 "	7.80
50 "	4.40		

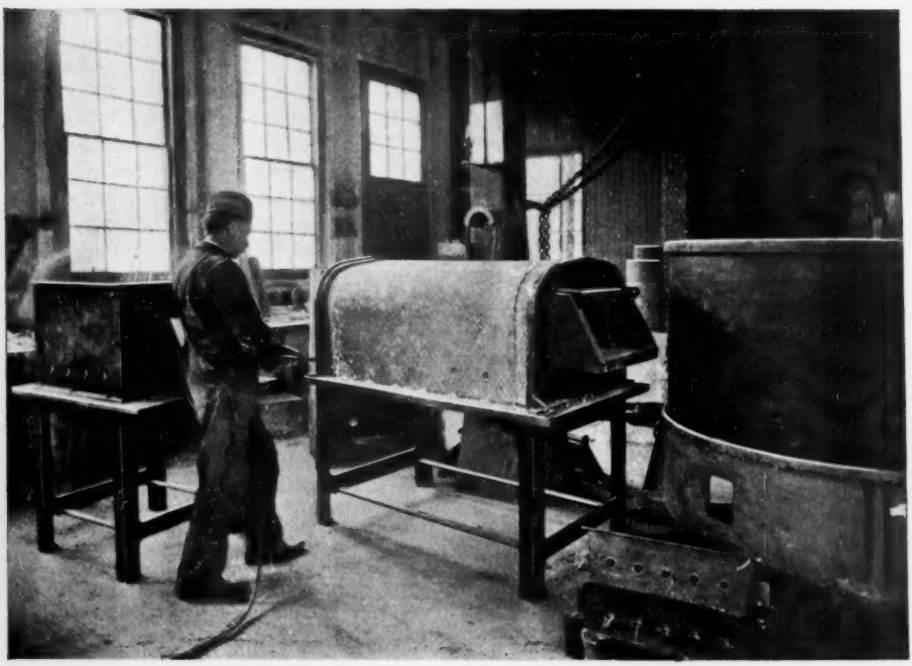
[To be continued.]

Use of the Pneumatic Clipping Tool in Shaping Refractory Materials for Furnace Work.

The cuts on following page illustrate the application of compressed air for shaping refractory materials for furnace work at the works of the American Gas Furnace Company, Elizabeth, N. J. The bricks warp while being burnt, and to make the surfaces and all joints accurate, and obviating an excess of fire clay at the joints, advantage is taken of the pneumatic chipping tool. Not only does this make an excellent surface, preventing the edges being broken off, as for instance when using a hammer and chisel, but holes can be bored accurately from markings made when outer steel shields or casings are applied for furnace and muffle work.

The air is delivered at 45 pounds pressure from a belt driven compressor. By means of an automatic arrangement only sufficient air is compressed to meet the demands of the chipping tools, thereby economizing the amount of power absorbed.

From actual tests a 2" hole six inches long can be bored in four minutes, and a 1¼" hole six inches long in three minutes; cutting a groove 1" x ¼" deep and 12" long in two minutes. Plain surface work is done very rapid and effectually. These figures fully demonstrate the economy of the use of air for this purpose, and also for hoisting the material about to be worked upon.



USE OF THE PNEUMATIC CHIPPING TOOL IN SHAPING REFRACTORY MATERIALS FOR FURNACE WORK.

Pneumatic Despatch Tube System in the Illinois Trust and Savings Bank Building, Chicago.

A few years ago a banking institution was thought to be complete if it had a good fire and burglar-proof vault and a trustworthy clerk to remain in the building during the night. As the years have passed improvements have been made, such as the time lock for vault doors, and now a secondary door with a time lock has been adopted as an extra safeguard in case the larger door fails to unlock. In other cities where they have the protective associations, the electric alarm system has been applied. Later came the telephone service, with a small central station in the building, connected with an instrument on the desk of every official, important clerk, and the heads of different departments, and also with the city central station. As a final improvement pneumatic tubes have been adopted. This necessity was first recognized by the First National Bank of Denver, next by the National Bank of Commerce in New York, and then by the Illinois Trust and Savings Bank of Chicago, where they have a complete equipment throughout their large building into which they have moved.

By the adoption of the pneumatic tube system, the officers, heads of departments, tellers and important clerks are in immediate communication with one another; that is to say, when a customer appears at the draft teller's window and asks for a draft, the same is made out, but he is not met with the familiar phrase, "Kindly step down to the vice-president or cashier with this draft and he will sign it." Instead, he waits just a moment while it is sent through the tube to the proper person, who signs it without delay and returns it to the teller ready for the customer. He is thus saved the bother of the trip to the vice-president; likewise the latter is saved the usual talk about the weather and business in general, which in most cases is not very much appreciated. The pneumatic tube system also saves the paying teller the trouble and time of ascertaining from the president or cashier of the institution if a certain check is acceptable. All he has to do is put the check in the carrier, dispatch it to the president's station and it is immediately returned to him with the O. K., or otherwise, upon it.

In citing the cases above, I showed briefly how the pneumatic tube system overcomes loss of time, bother and annoyance. I will now endeavor to give a brief description of the plant installed for the Illinois Trust and Savings Bank. In this particular instance the arrangement of the system was not decided upon until the building plans were too far advanced to make any alterations which would facilitate the construction of the tube system, therefore it was necessary to lay out the plant to the best advantage of all concerned under the existing circumstances. The work of designing, as well as installation, fell upon the writer. After ascertaining from the officers of the bank how they handled their business—that is, what offices were to be connected,—the next question was regarding the size of package to be sent through the tubes. It was finally decided that a bond would be the maximum size which would go into a carrier, the measurements being 9 inches long and internal diameter 1¾ ins. Then came the question whether or not the tubes could be laid under the floors and all concealed. After going into the matter very thoroughly, it was found that 2¼" outside diameter tubing could be laid in this way. As a result contracts were drawn up and signed for the following:

Ten lines of 2¼" o. d. tubes, No. 19 Stubbs gauge, connecting the following offices and departments:

President and Secretary.
President and Vice-President.
Vice-President and Draft Teller.

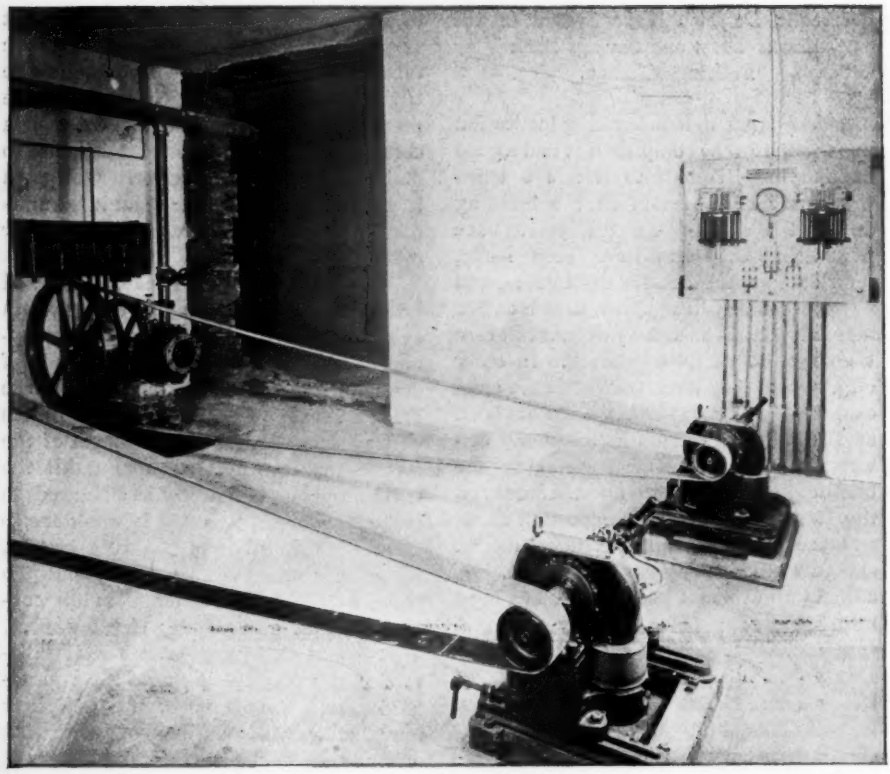


FIG. 1.—ELECTRIC DRIVEN AIR COMPRESSOR.

Cashier to Collections.
Cashier to Foreign Exchange and Bond Teller.
Cashier to Draft Teller.
Assistant Cashier to Collections.
Assistant Cashier to Foreign Exchange and Bond Teller.
Assistant Cashier to Draft Teller.
Collections to Trust Department.

As the building progressed the system was installed about as follows:

In the basement is located, adjoining and jointly with the sewerage disposal system, a two H. P. motor of the Crocker-Wheeler type (shown in Fig. 1), with a speed of 700 revolutions, running an 8 x 10 Ingersoll-Sergeant Compressor, at a speed of 100 revolutions. The necessary governing devices are controlled by the air pressure in the receiver or reservoir, the size of which is 4 ft. by 8 ft. The minimum pressure carried is 6 pounds, maximum 9 pounds. There are two air supply pipes leading to this reservoir, one on the south side and the other on the north side of the building. The diameter of these pipes is two inches, and they are reduced down proportionately until they reach the last station on their respective sides of the building. At different points along the line of these supply pipes ¾" diameter feeders are connected running to the several stations. The flooring in the corridors is marble, under which is a 2½" cement foundation, therefore two coats of as-

phaltum varnish was given all the pipes to prevent chemical action. The machinery once ready for operation, supply pipes and feeders were installed; then the work of laying the carrier tubes was commenced, part of the latter being laid in cement and part in cinders. The joints were made by means of sleeves and clamps, the former being well cemented to the pipe with shellac, making them absolutely air-tight.

The extra length of carriers and short turns called for a special curve made of cast iron, the radius of which was 15", enlarged in the centre so as to admit the easy passage of the carrier, shown in Fig. 2, and at the same time overcoming the difficulty of getting around sharp corners without cutting through the marble floor and wainscoting.

To prevent any possible damage to the tubing during the construction of the building by the workmen employed outside of our own, the tubes were tested each day by means of a small positive pressure blower, a carrier being forced through first one way and then the other. As soon as any obstruction was discovered it was immediately located, a short section

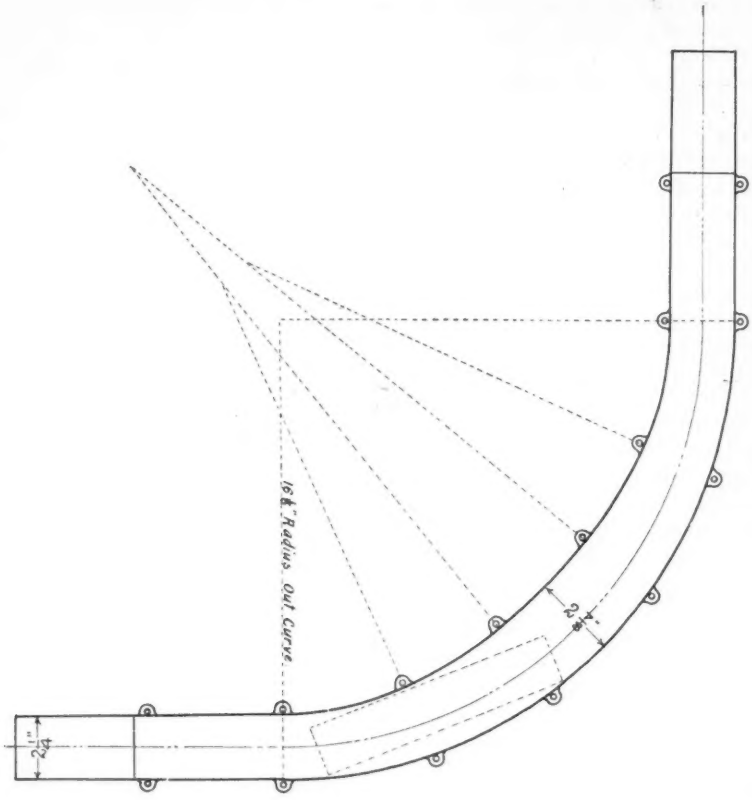


FIG. 2.—CURVE IN PNEUMATIC CARRIER SYSTEM.

removed, and if necessary new pieces substituted. It was generally found that these obstructions were dents caused by falling timber or sections of tile. In several instances the carpenters had driven nails through the tubing.

Fig. 3 (cover) shows the terminals in the office of the cashier and assistant cashier. Their desks (not shown in the cut) are located adjoining the cabinet on which the terminals are placed.

The operation of this system is about as follows:

The carrier is placed in the tube at the terminals, and the door, a sliding one, is closed, which opens a valve admitting air into the dispatch tube from the supply pipes, thus forcing the carrier through the tube to the other end, at which point it is discharged and falls on top of the cabinet for the purpose. As the carrier passes out of the terminal at the extreme end, it automatically closes an auxiliary door behind the carrier. This door closes the dispatch tube to the atmosphere, and therefore prevents the compressed air in the tube from escaping. The sudden stopping of the flow of air produces a pressure upon the diaphragm located in the terminal from which the carrier was dispatched. The diaphragm releases the valve, cutting off the air supply and at the same time opening a vent underneath the terminal, which allows the confined air in the dispatch tube to escape underneath the desk. In a second's duration the air has escaped and the door at the sending end of the tube, as well as the anxiliary door at the receiving end, opens and goes back to the normal position. The tube is then again ready for the sending of a carrier in either direction. The diaphragm controlling the valve in the supply pipe is regulated according to the length of the line. From test it shows that a speed of about 30 ft. per second is attained.

This system is known as the Automatic Pressure System, and differs from the continuous current or vacuum system in that only one carrier tube is used instead of a pair, and the air is compressed and stored in reservoirs or tanks and only used as needed. In this particular design of system the writer claims the following over other designs installed by him as well as others:

First—That the air confined in the dispatch tubes after the discharge of the carrier is allowed to escape underneath the cabinet on which the terminal is placed, thus doing away with the objectional noise in the room, the blowing away of papers if such should be left on the cabinet.

Second—In sending a carrier the door closes the tube to the atmosphere before opening the valve admitting air from the supply pipes.

Third—The valve action is absolutely positive.

On account of the high pressure maintained in the reservoir, the consumption of air is great, but the three difficulties overcome by this design outweigh the small extravagance. EDMUND A. FORDYCE.

Handling Switches and Signals.

The Nashville, Chattanooga & St. Louis Railway has six interlocking towers between the Union Passenger Station at Nashville and its shops, two miles distant, equipped with the pneumatic system of handling railway switches and signals, as devised by Mr. J. W. Thomas, Jr., and described in our October (1897) issue. These plants have 176 working levers, handling—

35 Switches,
19 Cross-overs,
4 Derails,
123 Signals, and
9 Crossing gates.

There is in use—

3½ miles of 3" main,
2 miles of 2" supplemental main, and
37 miles of ¾" pipe; the ¾" pipe being used for operating the switches and

signals, and getting indications from same.

Each tower is a block station, and we give below a statement of the trains handled between Union Passenger Station at Nashville and the Centennial Grounds, the railway terminal station being opposite their shops, for the six months ending October 31st, 1897:

STATEMENT OF TRAINS HANDLED BETWEEN NASHVILLE AND SHOPS—1897.

Morth.	No. of Trains.		Av'ge per Day.		Av. per W'rk Day		Highest Any Day	
	Single Track.	Double Track.	Single Track.	Double Track.	Single Track.	Double Track.	Single Track.	Double Track.
May.	7,136	6,639	230.2	214.2	253.3	230.3	284	263
June	7,356	6,892	245	229.7	266 5	247.2	292	280
July.	7,431	7,357	239.7	234.9	259.7	255.5	278	275
August	7,357	6,942	237.3	223.9	260.5	247.5	273	257
September	7,306	6,839	243.5	227.9	262.5	243.5	274	260
October.	7,599	7,106	245.1	229.2	269.5	253.4	314	306
Total, 6 months . .	44,179	41,775						
Ave. per month . . .	7,363	6,962	240.1	226.6	262	246 2		

These trains were handled by signals, no train orders having been issued. Notwithstanding the fact that the system was entirely new, was put up hurriedly, and the signalmen had very little previous training in interlocking work, the traffic was handled without accident, the maximum delay to any train being six minutes

Length of section of single track ..... ½ mile.
Length of double track..... 1½ miles.

481,525 passengers were handled between the Union Passenger Station and the Centennial Grounds, none of whom received the slightest injury.

Hydraulic Compression of Air.

At a recent meeting of the Manchester (England) Association of Engineers, Mr. H. D. Pearsall, of London, read a paper on "Hydraulic Plant for Compressing Air." Restricting the terms of his address to cases where water was the main agent—i. e., cases of the application of water power to the compression of air—he described various processes, the loss of energy in the application of which, he pointed out, had set back the development of that class of machine. Believing the principle to be right, he gave some consideration to the subject, and arrived at the conclusion that the imperfections were solely questions of design capable of rectification, and that the losses of power which were unavoidable were very small. He explained, by a series of drawings, an engine erected on the river Kent in Westmoreland, from designs he had prepared, the efficiency of which amounted to 80 per cent.,—that was, that the work done measured in isothermic compression of air was 80 per cent. of the gross power of the water When they compared that with the 30 per cent. or 35 per cent.,—and not that always,—which was commonly attained in piston compressors driven by water wheels, it must be admitted that the question of the use of compressed air assumed a totally new aspect. In a great variety of cases where with a low efficiency it was not worth while to use compressed air, or where electrical transmission, for instance, might be obviously preferable to transmission by compressed air, the case was entirely reversed if anything like an efficiency of 80 per cent. could be attained, and attained in machines of simpler and

less costly description than that which they superseded. Experience with the engiue had revealed still further possibilities of improvement. Finality had not been reached, and he did not say that an efficiency of 80 per cent. could be bettered, but in other directions, such as making an engine of the same size do more work, the engine would be improved on in subsequent engines. Other developments of the same principle had also been suggested by it which were not yet carried out in practice. —"American Manufacturer."

There has been considerable demand for a light, durable and easily handled breast drill, and the Empire Engine and Motor Co., of 26 Cortland street, New York city, has just brought out a machine to meet it. We show cut here of their No. 0 Pneumatic Breast Drill, a machine that has created the most favorable impression wherever it has gone. It weighs but 10½ pounds, with 60 to 70 pounds pressure, and with a 5-16 drill will go through 2 inches of ordinary cast iron in a minute. This is an invaluable tool for doing all classes of light drilling in fitting work, and driving test holes in columns in bridge and architectural iron works; driving test holes in stay bolts and running a burr drill for stay bolt holes in locomotive and railroad shops; boring for lag screws and running them in car building shops; running augers and driving in screws for general wood work; boring for name plates and drilling and tapping for putting on lagging.

PNEUMATIC BREAST DRILL.

We have enumerated a few of the uses to which this handy little tool can be put and for which it is well adapted. It is exceed-

ingly compact and well made, as a glance at the cut will show, and easily operated, a simple turn of the wrist being all that is required to start or stop it. The motor is of the rotary piston type, with the gearing all enclosed in the case. It is very durable, there being nothing to cause excessive wear and nothing to get out of order.

JETS OF AIR.

THE SAND BLAST.

A. R. Lynch, Foreman Painter of the P., C., C. & St. L. R.R., Dennison, Ohio, writes as follows to the Railroad Car Journal:

In recent issues of the Journal I see that much attention is being given to compressed air in its many and varied uses. It enters largely into the workings of the up-to-date paint shop. One of the best uses we have found for it at Dennison is the sand blast for removing old paint, scales, rust, etc., from locomotive tanks. I was at the convention at Old Point Comfort, but was not present during the discussion of this subject, and I was not a little surprised, and regretted very much to learn that the sand blast process did not have a greater number of friends and more enthusiastic support than it seems to have had. It certainly deserves the consideration of any one who has locomotive tanks to paint. We have been using it for abont eighteen months, and it has cost us, on an average, $2.50 per tank—some tanks being hard and some easy to blow off,—but should it cost twice that much I would consider the operation cheap, for all our tanks that have been treated with the sand blast are in excellent condition, showing no sign of rust or scales, and after having been in service over a year can be put in as good repair as new by cleaning and giving one coat of engine finish and relettering (or "cut-in" if you choose). This makes a saving of about $10 as compared to the usual way of repainting tanks. Considering the thoroughness of the cleaning and the durability of the work which follows, we are led to believe that there is no method so perfect and economical for removing old paint, scales and rust from tanks as the sand blast. At our shop the sand blast has come to stay, and after we have once gone over our tanks we will have no trouble with scaling or rusting nor any need of a "rust killer."

Mr. Robert Ross Zell, M. E., who is a Consulting and Superintending Engineer of Street Railways, Power Plants and General Engineering, of New Orleans, states that he has in course of construction a compressed air motor for street railway purposes. It is entirely new in design, using air up to 3000 pounds pressure without reducing the pressure. The air is used direct into the motor, and by a new system of re-heating the air while using, and reducing the pressure while doing work, Mr. Zell claims to have discovered a way of running cars with a consumption of not over 350 feet of air per car mile, against 500 feet as ordinarily. The weight of the motor is said to be very much less than others. These and other features promise an interesting development.

COMMUNICATIONS.

Under this heading will be published inquiries addressed to the Editor of COMPRESSED AIR. We wish to encourage our readers in the practice of making inquiries and expressing opinions.

We request that the rules governing such correspondence will be observed, viz: all communications should be written on one side of the paper only: they should be short and to the point.

Editor "Compressed Air"

MINNEAPOLIS, Minn., Dec. 31, '97.

Referring to the article written by Mr. G. D. Hiscox on "Cold Storage from Compressed Air" in your December number:

The refrigerating effect obtained by expanding compressed air through a small orifice is very small in proportion to the amount of work expended in compressing it, on account of the frictional resistance of the contracted opening. The compressed air should be expanded against a piston doing work, then exhausted through a large opening at very near atmospheric pressure, to get the maximum cooling effect from it. I have tried the first way, and know how it acts. See also the effect on steam of throttling, for proof.

MADISON COOPER, JR.

Editor "Compressed Air":

DEAR SIR,—The article in the December number of COMPRESSED AIR, entitled

"Cold Storage and Cold Rooms from Compressed Air," by G. D. Hiscox, is almost entirely theoretical in regard to the figures and data given, and admits of criticism for not impressing that fact more fully upon the mind of the reader. A person not familiar with the subject would be apt to arrive at erroneous conclusions after reading it; and if they were to put in a cold storage plant as figured and described, the writer is afraid that they would be sadly disappointed.

The statement is made in the first part of the article that "when by expansion to atmospheric pressure the same amount of heat may be eliminated from the expanding air as was accumulated by its compression, and from which a large cooling efficiency may be obtained," and later in the article some computations for cooling down a room of 1000 cu. ft. capacity are made, based on that assumption. The fact that the theoretical temperatures due to the expansion of cold air cannot be approached in practice, seems to have been entirely ignored.

The highest cooling efficiency with cold air is obtained by such machines as the Bell-Coleman Cold Air Machine and the Allen Dense Air Machine. Even with these machines the practical cooling effect is only a little over 40 per cent. of the theoretical cooling effect, and with an expansion orifice as described in article referred to, the cooling effect would be much lower, especially with the low pressure of 30 pounds per sq. in., as mentioned. In the cold air refrigerating machines referred to, the cooling effect is obtained by causing the air to do work in a regular engine. Theoretically the free expansion of air should produce no cooling effect, but actually there is some cooling effect, but not to the degree mentioned in Mr. Hiscox's article. If such a case is actually in practice where any great cooling effect is obtained with as low a pressure as 30 pounds to the sq. in., the writer would like very much to hear of it.

Very truly yours,

NEW YORK. W. H. DICKERSON, M. E.

IOWA CITY, Iowa, Jan. 3, '98.

Editor "Compressed Air,"

Allow me the privilege of commenting on the article in the last issue on "Cold Storage and Cold Rooms from Compressed Air."

The author states that the "amount of specific heat contained in a given volume of air is 1-800th of the amount contained in the same volume of water" per degree range of temp.

Specific heat is not an "amount," and while it is clear to see that he means the amount of heat, or heat units, his fraction is in error.

1 lb. air = 13 cu.ft. = .2377 heat units per deg. range temp.

13 cu.ft. H_2O = 800 + lbs. = 860 + heat units per deg. range temp.

$$\text{Ratio} = \frac{1}{3200} \text{ about.}$$

Again having determined that 841 h. u. must be absorbed from a certain room to reduce it to 34° F., he first calculates that air at — 138° warmed to + 34° (as min.) will give range of — 138 + 60 = 198°.

But supposing this did not include error, he says:

"Then $\frac{841}{198}$ = 4.24 lbs. or 55½ cu. ft. of free air at 30 lbs. pressure will be required to cool the room to 34° "—or say 25 per cent. of the amount required.

A. V. SIMS.

State University of Iowa.
Dept. of Civil Engin'g.

PNEUMATIC APPLIANCES.

PATENTS GRANTED DECEMBER, 1897.

Specially prepared for COMPRESSED AIR from the Patent Office files by Grafton L. McGill, Washington, D. C.

594,891, — Pneumatic Motor for Musical Instruments. T. P. Brown, Worcester, Mass.

A channel-board is provided with main and supplemental air-channels, each opening outward through the front face of the board. A series of bellows are arranged upon the rear face of the

channel-board, each having an air passage leading to one of the supplemental air-channels. A crank-shaft is provided with a number of crank-arms corresponding to the number of bellows, while an independent pitman connects each crank-arm and bellows. Slide-valves, each having a recess adapted to move over the openings in the face of the channel-board, are connected by said independent pitman to each crank-arm.

595,654.—Air-Controlling Device. Alfred Roesch, Brooklyn, N. Y.

An air-chamber is provided with inlet and outlet air-ducts the ports of which are controlled by a double or two-faced elastic valve, interposed between said ducts. An open side duct forms communication between the air-chamber and a steam-controlling valve. A valve-supporting stem connects with the double or two-faced valve within said air-chamber, from the exterior. This valve-supporting stem is provided with a flange secured to the centre thereof, and two side-flanges which are adapted to hold and compress the double and elastic valves, which latter are loosely fitted upon their supporting stem and separated from each other by the said central flange.

596,211.—Pneumatic Conveyor. S H. Jones, Newark, N. J.

The object of this invention is to provide means for transferring comminuted material. It consists of a floating chamber charged with compressed air having lateral doors for the introduction of the receptacle containing the material to be transferred. A discharge-pipe with a freely-movable inner end, and an agitator projected in advance thereof, leads from the interior of the chamber and is adapted to reach all parts of the said receptacle for the removal of its contents.

596,212. — Dry Kiln. Franklin Kirk, Kansas City, Mo.

An apparatus for heating lumber is provided with means for introducing dry air into the kiln, and exhausting moistened air therefrom. The device consists of a fan blower having a pipe connected thereto and provided with a condenser. A second pipe extends longitudinally and centrally of the kiln below the heating apparatus and is provided with perforated branch pipes arranged at the underside of, and adapted to discharge upon, the heating apparatus, while a third perforated pipe in the upper portion of the kiln receives the moistened air and passes it back to the fan blower.

956,307.—Pneumatic Stacker. G. W. Quinn, Bloomington, Ill.

This device is an improved stacker for corn-shellers, by means of which the chaff and dust are separated from the corn. It consists of a fan-casing to receive the cobs and chaff, and a stacker-tube open at both ends, one of said ends communicating with the interior of the casing, while near its other end the tube is provided with a lateral cob-discharge opening, and a second opening for the chaff-discharge. A deflector is adapted to guide the cobs to said cob-discharge opening and permit the passage of the chaff. An air-conduit terminating adjacent the cob-discharge opening is arranged to direct its blast across the same toward the chaff-discharge opening.

596,175.—Drying Apparatus. McClatchey and Krum, Chicago, Ill.

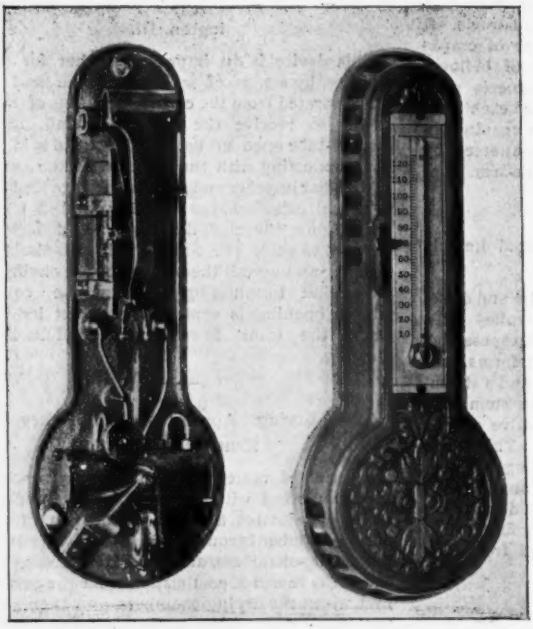
A series of material-containing drying-chambers, connected with one another in circulating series, are situated above a combustion furnace. An air-chamber is connected with the interiors of the drying-chambers, and conduting passages circulate the fumes of combustion from the furnace, first, about the drying-chambers, and then about the air-chamber, while a circulation of air from the air-chamber is thrown into and through the drying-chambers.

595,890.—Pneumatic Despatch Tube. C. F. Pike, Philadelphia, Pa.

The tube is provided with a smooth circular bore and trackways, the latter consisting of two longitudinally-disposed rails integral with the walls of the tube. The rails protrude a short distance inwardly in the tube and are diametrically opposite each other in a vertical line, presenting a clearance in the bore of the tube for the passage of the carrier approximately equal to the area of the bore of the tube in cross section.

595,429.—Air or Gas Pump, or Compressor. L. R. Alberger, New York.

A duplex direct-acting air or gas pump provided with means for securing communication between the opposite ends of the respective cylinders at the end of each stroke, and for admitting fluid to the cylinders from another source to increase the pressure in front of the plungers above the suction pressure at or near the commencement of each compression stroke.



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That it has purchased all of the patent rights, drawings, special tools and stock on hand of the former manufacturers of the "Wolstencroft" Pneumatic Tool;

That it has purchased all of the patent rights, drawings, special tools and stock on hand of the former manufacturers of the "Keller" Pneumatic Tool;

That it has developed and perfected a new Pneumatic Tool, known as the "Consolidated," which combines all that is best in its numerous patents, and is the simplest, best cutting, least vibrating and most economical Tool ever produced;

That it is prepared to supply either the "Wolstencroft" or "Keller," or new "Consolidated types of Pneumatic Tools" in any size, suitable for cutting or carving granite, marble, brown-stone, blue-stone, onyx, etc., at the uniform and absolute price of SIXTY DOLLARS ($60) PER TOOL.

That it will send any or all patterns and sizes of Tools upon TEN DAYS' TRIAL, subject to acceptance or return at the expiration of that period, thus permitting the tools to stand entirely upon their merits and be their own arguments.

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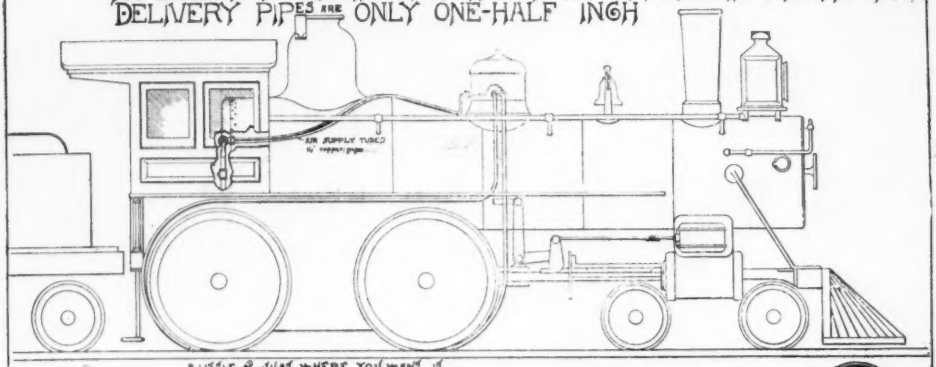

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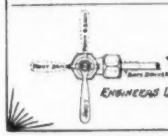
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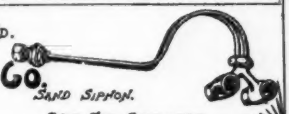
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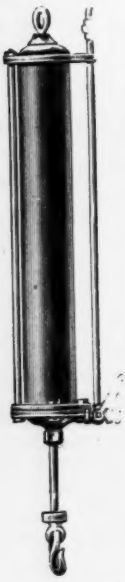

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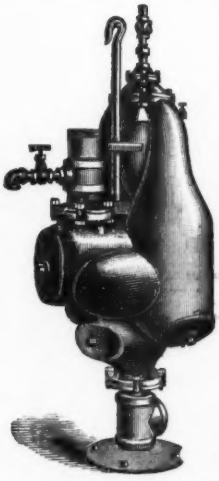

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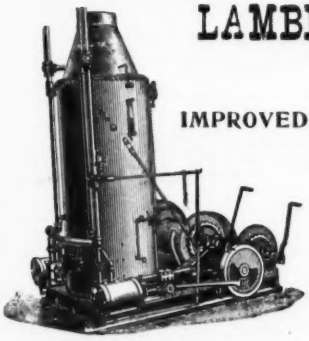

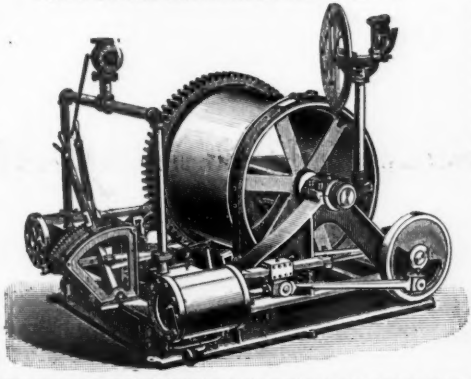

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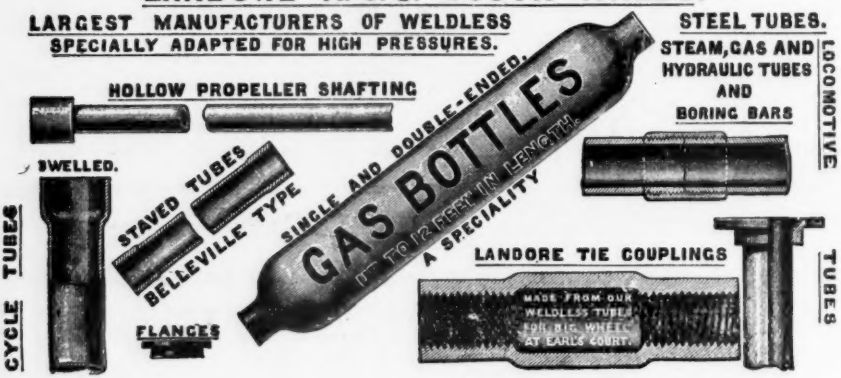

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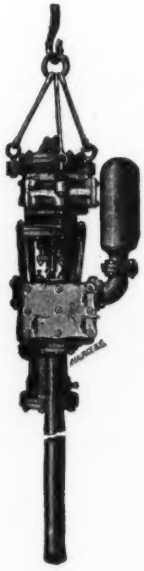

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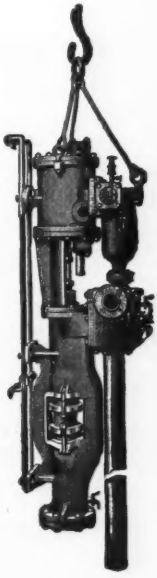

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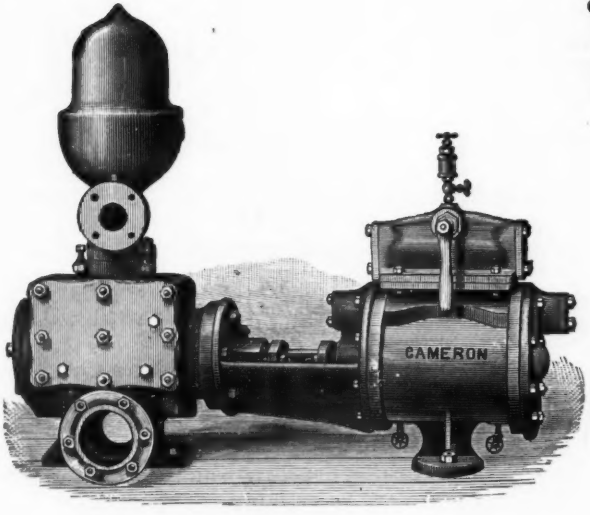

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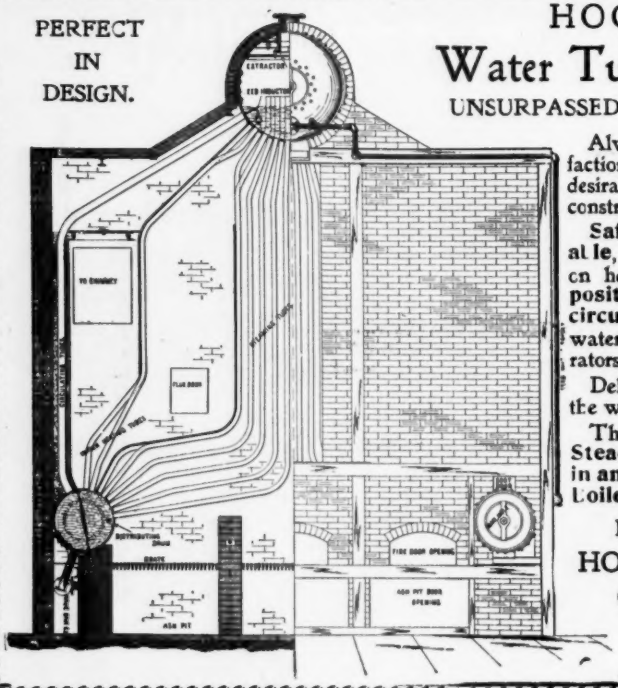

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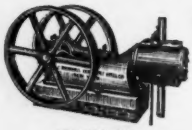

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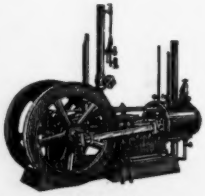

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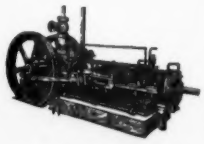

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